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INTERIM REPORT ON ECONOMIC AND MANPOWER FORECASTING. VOLUME I.(U)
JUL 79 N00014-76-C-0782

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INTERIM REPORT

FOR

OFFICE OF NAVAL RESEARCH

(15) [redacted] N00014-76-C-0782

(11) JUL[redacted]79

Volume I

(6) [redacted] Interim Report on Ecomomic and Manpower Forecasting. Volume I.

(12) 82

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I. INTRODUCTION

This report summarizes the research conducted during the second year of the Wharton Econometric Forecasting Associates project for the Office of Naval Research. The main thrust of the research is to evaluate the labor supply needs and potential of the Navy in the context of an overall econometric model.

To address the issue of the labor supply availability to the Navy, particular emphasis has been given to the long-run interaction between econometric and demographic variables. To capture these effects, labor force participation and unemployment rate equations were estimated for fourteen age-sex groups. The specific age groups, for males and females, are 16-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65+. Particular stress has been placed on the specification of the equations for the younger age groups, 16-19, and 20-24. In addition to the labor force and unemployment equations, school enrollment equations have been developed for males and females in the 16-19 and 20-24 age categories.

The labor force model is based on what hereafter is called, "the cohort overcrowding model." This approach pays particular attention to the importance of the changing age structure of the population. In particular, it stresses the lack of substitution between young and old workers and the various problems that evolve when an economy has either an abudance or scarcity of young workers. This imbalance in the labor force, and its

changing pattern over the next decade, has important implications for the ability of the "All Volunteer Forces" (AVF) to meet quantity and quality personnel objectives in the 1980's and 90's.

The labor force and unemployment equations have been integrated into both the annual and quarterly WEFA models. Forecasts for these variables are now a component of the WEFA forecast. The school enrollment equations, due to data availability problems, are only included in the annual model. The Armed Forces enlistment equations, both for the Navy and Armed Forces in general, have been estimated using ordinary least squares. These equations have not yet been finalized and included in the Wharton model. It was anticipated that this would be part of the third year of the study. Further work is needed on the time series specification of Navy manpower labor flows.

This demographic-economic model can be used as a central component in analyzing potential problem areas for Navy recruitment over the next decade.

Since the initiation of the All Volunteer Armed Forces several years ago, the military has faced uncertainty about its ability to attract and retain the necessary manpower. To date, however, the AVF has been relatively successful in recruiting volunteers. Still, as new problems are anticipated in the next decade, serious doubts remain concerning the program's feasibility. In particular, can the Navy and other branches of the Armed Forces effectively maintain their manpower quotas in a period during

which the number of young people will be declining? What sort of competition will the Navy face in recruiting young people in the 1980's? What wage and benefit level will have to be paid in order to attract workers with different skills? Can the Navy alter its traditional reliance on younger workers of particular educational quality and draw from a broader pool of older and/or less skilled workers? Some of the answers to these questions are implicit in the work already completed. Specific, quantitive solutions, however, would require simulations based on the Wharton model and including the new labor market equations and the Navy and Armed Forces equations.

The basic research plan was the following: First, the unemployment, labor force, and school enrollment equations were estimated using annual and quarterly data. These equations were conceptually linked together using the cohort overcrowding model. Additional explanatory variables were also included in the various equations. The second stage was the incorporation of the unemployment, labor force, and school enrollment equations into the Wharton quarterly and annual models. Prior to the research for the Office of Naval Research, the WEFA models had detailed specifications of the labor demand side of the economy. Few equations, however, dealt with the labor supply side of the economy. This problem has been solved so that WEFA now has a detailed interactive, economic-demographic, model of the labor sector. The third task was the specification of the Navy recruitment equations. This work has also been completed. The

fourth task, which was reserved for the final year of the project, was the development of more detailed manpower flow equations for the Navy and integration of the equations into the Wharton model. Simulations based on alternative assumptions for the exogenous variables could then describe potential enlistment problems that might develop in the 1980's.

The outline of the report is the following: Section 2 describes the cohort overcrowding model. Section 3 presents the labor force participation, unemployment and school enrollment equations. Section 4 outlines the military enlistment model. Section 5 presents the labor supply projection for the 1980's and its implications for the Navy. Section 6 highlights the major findings.

II. THE COHORT OVERCROWDING MODEL

The cohort overcrowding model should be analyzed in the context of the sharp swings in the fertility rate that have occurred over the past several decades. Specifically, the current structure of the U.S. population is a reflection of three dramatic shifts in the fertility rate. The first occurred with the Great Depression. At that time the total fertility rate declined as did the total number of births. The second major shift was the baby boom of the late 1940's and early 50's. At the peak of the baby boom in 1957, completed family size had almost doubled from its Depression lows of 2.1 to 3.8 children per family with the total number of births at over 4 million per year, (compared with a Depression low of 2.3 million). The level of births remained at a high level through 1962, and then began a dramatic decline that continued through 1978. As of 1976, the total fertility rate was approximately 1.8 and the total number of births had declined to a total of 3.1 million per year.

As a consequence of the three shifts in the fertility rate, the age structure of the United States' population is in severe imbalance. On the one end is the small group of 0 to 16 year olds in the baby bust cohort. In the middle is the large group of 16 to 35 year olds or the baby boom cohort. Yet it is neither the high nor the low fertility rates themselves that cause problems since an extended period of either high or low population growth would eventually yield a stable and uniform structure.

Instead, it is the rapid swings in the fertility rate and the resulting imbalances in the different age cohorts that produce major adjustment problems for the economy.

The cohort overcrowding model has two essential components. The first is that younger and older workers differ from each other in their specific or job related training. In the short-run, young inexperienced workers cannot replace older workers who are better trained in performing specific tasks. Shifts in the relative supply of young vs. old workers in relation to the normal demand for the two types of workers will alter the wages, employment conditions and upward mobility of the two groups. For example, when younger workers are in relatively short supply compared with older workers, their wages, employment conditions and upward mobility will be favorably affected. When there is a surplus of younger workers, cohort overcrowding, their situation will be comparatively unfavorable: unemployment rates will increase, relative wages will fall and opportunties for advancement will suffer. Indeed, given the low elasticites of substitution between more and less skilled workers in the short-run, the relative adverse adjustments can be quite large.

The second component of the model is that young adults develop aspiration levels based on the standards of living they experience when growing up. Not only do young adults expect to do as well as their parents, but, in addition, they anticipate some improvement due to the ongoing increase in income in the United States.

The interrelationship between the formation of aspiration levels and the imperfect substitution between younger and older workers in production can be explored by analyzing the sharp shifts in fertility that have occurred since the 1930's. During the Great Depression, the standard of living for young workers fell quite significantly. On the other hand, aspiration levels, developed during the upbeat decade of the 1920's, were relatively high. In order to maintain living standards as close to their aspiration levels as possible, young families had fewer children and the wife was more likely to enter the labor force. With income to be divided among fewer family members, family per capita income was increased. In addition, since children are expensive commodities in terms of time as well as goods, lowered birth rates mean greater free time for family members to work in the labor force. The result is an upswing in labor force participation rates associated with the downswing in the fertility rate.

With the end of the Great Depression and the beginning of World War II, an entirely new situation existed in the labor market. The new entrants into the labor market were the children who had grown up during the Great Depression. As a result of their parent's lowered standards of living acquired during the Great Depression, their aspirations were fixed at a low level. Indeed, they expected to age and mature in a labor market with at least the threat of secular stagnation and continuing depression.

This cohort, however, was very small in size. As a consequence, the demand for this entering group of workers increased their wages dramatically.

In addition, the adoption of Keynesian economics after World War II, meant that demand related shifts, similar to those occurring during the Great Depression, could be dampened by monetary and fiscal policies. This enabled the economy to escape from the threat of secular stagnation. As a consequence, the young adults of the 1940's and the 50's faced a favorable labor market. This generated potential living standards significantly above the aspiration levels that had developed during the Great Depression. The result was a sharp upswing in the fertility rate. In other words, as families achieved their desired standard of living with one wage earner, they could afford the time and expense of additional children. As fertility rates increased, the trend rate of growth of female labor force participation slowed as many could now afford to stay home to raise the children of the baby boom.

The children of the baby boom grew up in an atmosphere of continuing increases in wealth and per capita income. Their aspiration levels, therefore, were fixed not only by the high standards of living enjoyed by their parents, but also by the notion that upward mobility was a feature of American life. As the baby boom generation entered the labor market, however, they found the conditions very different than those that they had expected. Competing with a large group of entry level workers, their relative wages were bid down and their promotion possibilities were less

apparent. One result was that newly formed families found that they could not possibly afford to have a full-time housewife raising 3.8 children. Either family size or aspiration levels would have to be modified. The result was a sharp decrease in the fertility rate and a sharp increase in the labor force participation rates of younger women. Yet the induced change in participation rates served to aggravate the existing oversupply problem of young workers, further driving down relative wages. The net effect was the baby bust cycle which began in the middle to late 1960's and has continued through the present day.

But what of the future? As the baby bust generation begins to enter the labor market, young workers will be in increasingly short supply. This will generate an improvement in their labor market situtaion and will result in relative wages well above those of the baby boom cohort. Given relatively low aspiration levels developed during the 1960's and 1970's, this next cohort will find it much easier to earn high incomes and gain rapid promotions. A growth in relative well being encourages earlier marriage and childbearing. That is, over the next two decades as the baby bust cohort moves into the labor market, the U.S. will revert to a condition of growing scarcity of young people. Although this condition is receptive to increases in the fertility rate, the increasing number of births cannot relieve the labor market shortages until the year 2000. In the meantime, a shortage of young males, higher relative wages for young

workers, and a reduced growth rate of the overall labor supply suggest a competitive and expensive labor market in the age cohorts where military enlistments are concentrated.

III. LABOR MARKET AND SCHOOL ENROLLMENT EQUATIONS

The major thrust of the research in the initial two years of the ONR contract was to develop a fully specified labor supply model within the WEFA framework. The labor supply or total man-hours available to the economy is equal to the population (age 16+), multiplied by both the labor force participation rate and average hours of work. Greater complexity can be added by including a measure of labor quality through the introduction of an education variable. Finally, immigration flows, can be included, either as part of the population variable or as a separate component. The Armed Forces and the Navy, in an AVF framework compete with the civilian sector for manhours. The purpose of the research is to specify the factors that determine the size of the labor supply and/or total manhours and then to analyze the factors that determine the Navy's share of the available labor supply and the dollar cost of attracting and retaining the desired supply.

A. The Components of the Labor Supply

As mentioned above, the basic labor supply can be divided into three major components: population, labor force participation rates, and hours of work. Additional complexity can be added by including labor quality and immigration.

Of the three basic components, future changes in labor force participation rates are the key variables in determining the labor supply over the 1980's. The size of the working-age population is known with some reliability over the next decade. Although a birth rate equation is now being included, future changes in fertility rates will not start affecting the working-age population until at least the year 1995. For example, those born in 1979 will not enter the prime age 25-54 category until the year 2004. (Mortality rates show little short-run change and this is especially true for the working age population). The hours of work component of the labor supply presents somewhat greater problems than population. Relatively little work has been done on projecting hours of work. The prevailing view, however, is that future hours of work are likely to be largely unchanged from current hours. As shown in Table 1, after several decades of declining hours of work, the trend halted after World War II. Between 1947 and 1978, hours of work have shown little change. Aggregate series, that combine full and part-time workers, do show some decline due to the increasing percentage of part-time workers. But full-time work schedules, even adjusting for

Table 1

Average Weekly Hours

Year	Hours
1901	58.4
1906	57.0
1913	55.0
1919	50.0
1923	49.6
1926	49.3
1929	48.7
1948	41.6
1953	41.4
1956	41.8
1966	42.1
1969	42.0
1977	41.3

Source: John D. Owen, "Hours of Work in the Long Run: Trends, Explanations, Scenarios, and Implications," Work Time and Employment, National Commission for Manpower Policy, Special Report No. 28, October 1978.

increasing vacation time, sick days, etc., seem to exhibit little movement. Thus, given reliable population projections for the working age population and assuming little change in hours of work, predicting the labor force participation rates of the various age-sex groups will determine the success of forecasting the labor force.

B. Labor Force Participation Rates

The labor force participation equations introduced into the annual model are similar to those discussed in the first year report of this contract. Equations are estimated for the standard fourteen age-sex groups of the Bureau of Labor Statistics using nationwide data. They are depicted in equations 19-32 in Appendix I of this volume.

Several basic variables are used to explain past labor force participation behavior and then to predict future behavior for the fourteen age-sex groups. The first variable, a measure of labor market tightness, tests for cyclical changes in the labor force. The specific variable utilized is the prime-age male unemployment rate. It was generally signficant in all of the male equations.

The second variable is a real wage or income variable. The former was used in the female equations to measure the opportunity cost of market vs. home work. Historically, female working activity was concentrated in the home. With education and real wages increasing, females have been switching from home to market work. (This assumes a low income elasticity for home produced goods).

For the male participation equations real income, as distinct from wages, is used. The income variable is negative in the male equations capturing the declining male participation rates. It is not clear from the data, however, whether this decline

means that some males are dropping out of the labor force permanently or that a larger number are engaging in transitory nonparticipation. As can be seen, the coefficients on the income variable are much higher for older males, which suggests that the declining participation rate is related to early retirement for these groups. In the male equations, a five period fixed-weighted average or real per capita disposable income is used as the real income measure. The income variable used in the female equation is a per employee wage rate deflated by the price deflator for overall consumer expenditures.

The third variable is a cohort related variable. Two alternative variables were used to measure cohort effects: either the percentage of persons age 16-34 relative to the total population age 16 (denoted RPY) or the total fertility rate (denoted NPER). These variables measure the effects, on labor force behavior, of the relative size of the younger cohort. Such variables are needed since age groups, drawn from different cohorts, are likely to face different employment opportunities. For example, the current group of workers age 16-34 is an extremely large cohort; namely the baby boom group. Ten years from now, the 16-34 age group will consist of the smaller baby bust generation.

The economic assumption underlying the cohort effect is the notion that various age-sex groups are imperfect substitutes for one another. Young workers and new entrants into the labor market lack specific training and therefore cannot compete effec-

tively with prime-age males who have acquired training as a consequence of their ongoing labor-market attachment. An imbalance of young workers caused, for example, by the entry of the baby-boom cohort into the labor force, results in an increase in the relative unemployment rate and a decrease in the relative income of the younger workers. The adverse market conditions, in turn, may induce an increase in the participation rate, especially of females and teenagers, to compensate for the reduction in the income of the primary workers. For older workers, improved relative labor market conditions yield a decline in the participation rates of secondary workers.

Some equation specific results for the various age-sex labor force participation rate equations are discussed below. The equations estimated are shown in Appendix I (see Equations 19-32).

The male equations and one of the female equations include the proportion of the civilian noninstitutional population sixteen and over that is 35 years of age (denoted RPY). For females, the demographic overcrowding effect is captured by the total fertility rate (NPFR). The influx of the baby boom cohort in the 1960's and 1970's led to a reduction in the birth rate of females as they sought to maintain desired living standards. The decline in fertility rates reduces not only the expenditures related to childrearing, but also the amount of time needed at home. With less of a time constraint related to home work, females

were better able to engage in market work.

For males and females 16-24, a somewhat different specification of the labor force participation equation was used. For males 16-24 and females 16-19 the school enrollment rate was introduced as an independent variable. This captures the trade-off faced by youth of market vs. school work. Since school enrollment is an endogenous variable, school enrollment rates were also included in the model. In addition, for young males an Armed Forces variable was included. This allows the model to simulate the various feedbacks between the size of the military and key labor market variables.

Males 16-19

For this cohort, the relative population variable, RPY, was elimimated in order to improve the performance of the estimated equation. The unemployment rate for prime age males, the school enrollment rate, and the armed forces rate all proved to be significant variables and to have the correct signs. The coefficients of the armed forces term is quite large but this reflects, in part, the predominance of the younger age groups in military service.

Males 20-24

The RPY variable was again eliminated because it was statistically insignificant.The overall significance of the other variables of this cohort is similar to those of the 16-19 age

cohort. The school enrollment rate variable and the armed forces variable have very significant coefficients. The elasticites of the enrollment rate and the armed forces variable, at the mean values, are -.0873 and -.0532, respectively. The income variable also shows a correct sign and is significant. The implied elasticity is -.06 which is less elastic than that of the younger age group. The unemployment rate showed a correct sign, but the t-value of this variable is the lowest among all the male groups. This result implies that a relatively higher proportion of this group may be working in the less cyclical industries.

Males 25-34, 35-44, 45-54

These three cohorts form the prime-age group. Their participation rates have always been high and fairly stable over time. The participation behavior of these groups is not highly sensitive to the business cycle. Three variables were utilized to explain the variations of the dependent variables of these groups. The RPY variable has negative and significant coefficients as expected. As was discussed earlier, the RPY variable represents the relative income status of the cohort. The relative income data show that the incomes of these groups have increased relative to the other cohorts since the early 1950's Therefore, the negative coefficients are expected based on the cohort overcrowding theory. The income variable also has correct

signs for all the groups and are very significant. It is interesting to note that the income elasticities are higher for the older age groups.

Males 55-64

The behavior of this group is very similar to that of the prime-age males. The same three explanatory variables turn out to be significant and have the correct signs. The elasticites of both the unemployment rate and the income variable are larger than those for the prime-age male groups.

Males 65 and over

The autoregressive functional form was adopted only for this oldest age group. Since most people in this age category are already retired from the work force, their participation behavior can be predicted on the basis of their own past work history. The three other explanatory variables, especially the prime-age male unemployment rate, have significant coefficients.

Female Equations

The specification of the female labor force participation equations is essentially the same as in the first year report. The implication of the relationship between the total fertility rate and the labor force participation behavior was discussed in detail on the basis of the cohort overcrowding model in that report.

Female 16-19

The school enrollment rate variable has the correct sign and is significant. The implied elasticity at the mean value is -1.37. The wage variable has a positive coefficient, as expected, since the variable is used to capture the substitution effect across different work related activities. This coefficient implies an elasticity of .63 calculated at the mean. The negative coefficient on the fertility rate, NPER, is the expected sign. The relative population turned out to be insignificant, undoubtedly due to collinearity with the fertility rate. The cohort over-crowding theory does imply a close relationship between these two variables.

Females 25-34

For women age 25-34, the fertility rate is strongly significant with an elasticity of -.577. The wage variable has the smallest effect for this age group than for the other female groups. This seems to indicate a more dominant role for the interaction between fertility and labor force participation in this age group.

Females 35-44, 45-54, 55-64

For the age groups between 35 and 64 years old, a lagged fertility rate was used in order to capture the lifetime fertility pattern of the cohort being modelled. The average or mean lag was nine years for the 35 to 44 year old group, nineteen years for the 45-54 year old group, and twenty-nine years for the

55 to 64 year old group. This variable is highly significant in each equation except the 45 to 54 year old group. This age group's equation has a poorer fit in general. The wage coefficients were very significant in all three equations.

Females 65 and over

In this equation only a relative population measure was found satisfactory. The negative sign observed is consistent with the cohort overcrowding theory. An increase in the relative share of population between 16 and 34 permits accelerated retirement. The large working age population creates an inflow of funds into public and private pension funds. Moreover, the older age group was part of a relatively small cohort that had relatively favorable working conditions during their working years.

C. School Enrollment Equations

School enrollment rates are particularly important in determining the potential military labor market pool. Fluctuations in school enrollment rates have two direct effects on the manpower pool. First, lower enrollment rates mean that more individuals are looking for jobs and may be available to the military. Second, lower enrollment rates translate into lower years of school completed. This suggests a larger number, but a lower quality of potential enlistees. The school enrollment equations are shown in equations 11 through 15 in appendix 1. A more detailed discussion of the school enrollment rate equation and the relevant empirical literature is available on request, see Kim (1979). The work by Kim was an important component of the ONR research and provides the basis for the equations in Section III C and IV.

The basic variables in the school enrollment equation are the minimum wage rate, the size of the armed forces or a proxy for draft pressure, a measure of family income, an indicator of unemployment and the level of real per capita government expenditures on education. The minimum wage rate, is introduced as a relative wage term; that is, the statutory minimum wage divided by the average wage for the overall economy. It is included to measure the possible negative effect of minimum wages on employment. Since schooling is an alternative to employment for younger workers, minimum wage increases, by reducing the number of jobs available to youths, could increase school enrollment.

An alternative explanation of the same variable can be based on a reservation wage or supply side argument. A low relative market wage, relative to the minimum wage, discourages employment. When current wages are low, relative to some social minimum, such as the minimum wage, young people are more likely to remain in school rather than seek work opportunities.

The draft pressure or armed forces variable captures the effect of the draft and military enlistments on school enrollment. The recruitment rate is used as a proxy for the draft pressure effect. Remaining in school used to be a way of avoiding being drafted into military service. Hence, the greater the draft pressure, the higher the school enrollment rate. Since the draft proxy variable is equal to the recruitment rate during the draft period and zero elsewhere, it captures some of the effects of the institutional changes associated with the draft.

The family income measure is defined as the ratio of the current real family income divided by the expected real family income. A positive relationship between school enrollment and family income should be expected. This is due to the fact that parental support is the most important financial source for education and the fact that education is partly a consumption good with a high income elasticity.

A real per capita government expenditure on education variable was included in the equations to capture its impact on the quality of educational services being offered. This is presumed to positively effect the prospective school enrollee's perception of the expected return on further years of schooling.

D. Age-Sex Specific Unemployment Equations

Two straightforward reduced form equations determine the distribution of unemployment. The unemployment rate for prime age males is determined by three equations of the following structural form for each age group (25-34, 35-44, and 45-54):

$$\ln (U_i) = C_i + \sum_{j=1}^{3} a_i \ln \frac{(N-j)}{N-j-1}$$

where "N" is total number employed and the coefficient "a_i" has a polynomial distribution of degree one, constrained to equal zero for j=4. An alternative equation was considered for the 25 to 34 year old age group that included, in addition to the employment variable, a lag distribution for the number in the labor force for that age group.

For age-sex groups other than prime-age males the following form was used:

$$\ln (U_i) = ci + a_i{*} \ln (UPM) + b_i{*} \ln (RPY)$$

where UPM is the unemployment rate for prime age males and RPY is the proportion of sixteen and over civilian noninstitutional population that is between the ages of sixteen and thirty-four.

A distinction between the employment performance of prime age males and other labor force groups is commonly made in investigations of unemployment. Unemployment rates for these workers have historically been much lower than those for other groups and have been much less volatile. Participation rates have been most stable for this group--a primary family breadwinner would be

expected to be harder to "discourage." For this reason the unemployment rate for prime age males has been responsive primarily to fluctuations in final demand, and so is a more accurate barometer of cyclical swings. A distributed lag of first differences (in log form) in total employment is thus the most sensible linkage to the WEFA macroeconomic model.

The inclusion of the prime age male rate in the remaining unemployment rate equations accounts for those overall demand side determinants of a groups' unemployment rate. The relative population variable accounts for demographic shifts affecting the labor supply for each age-sex category. The coefficients on this variable indicates whether a group increases its relative supply when younger workers are more abundant ($b>0$) or whether a group decreases in supply when young workers are more abundant ($b<0$). These coefficients were positive, as expected, in the young male equations and in all female equations, and negative for older male groups. These equations appear in Appendix I, numbered 33 through 47.

The age-sex unemployment equations can also be used to calculate full-employment, unemployment rates (denoted U_N). Alternatively, this technique can be viewed as "normalizing" the unemployment rate for the changing demographic composition of the labor force.

The basic assumption utilized here is that the structural changes in the labor market have had the smallest impact on prime-age males. These workers show very little cyclical

variation in their labor force behavior and are not significantly affected by changes in government transfer payments and minimum wage coverage. Using the prime-age male group (25-54 years of age) as a benchmark, it is possible to estimate the structural increase in unemployment of the standard age-sex categories in the labor force. The relevant equation is:

$$\ln (U_i) = c_i + a_i * \ln (UPM) + b_i * \ln(RPY)$$

To calculate the normalized unemployment rate for each age-sex group, it is assumed that 2.9% is the equilibrium level for UPM. The 2.9 figure is a benchmark, and the resulting U_N figures are indexed on the particular benchmark. If the 2.9 is changed, the U_N's will also change in the same direction. The choice of that number is based on an examination of inflation and UPM data for the postwar period. Essentially, in the postwar period, UPM has been below 2.9% during clear period of excess demand, 1956:2-1957:2, 1965:2-1970:2, and 1972:4-1974:3.

Substituting into the unemployment equations the estimated values for c_i, a_i, and b_i in each age-sex equation and 2.9% for UPM leads to an estimate of the normalized unemployment rate for each age-sex group (U_N^i). They vary over the period as RPY changes. The demographic corrected U_N figure for the economy at any point in time is then a weighted average of the U_N^i for each of the fourteen age-sex groups. The weights are the percentage of each group in the labor force. Table 2 shows the aggregate U_N series for the 1948 to 1978 period and Table 3 presents the U_N for the fourteen age-sex groups for various years between 1955 and 1978.

Table 2

Full Employment or

Noninflationary Unemployment

United States 1948-1978

Year	U_N	Year	U_N
1948	4.51	1963	4.35
1949	4.41	1964	4.46
1950	4.34	1965	4.61
1951	4.18	1966	4.74
1952	4.07	1967	4.78
1953	3.97	1968	4.81
1954	3.94	1969	4.92
1955	3.97	1970	5.03
1956	3.99	1971	5.16
1957	4.01	1972	5.29
1958	4.04	1973	5.39
1959	4.10	1974	5.42
1960	4.19	1975	5.44
1961	4.23	1976	5.47
1962	4.24	1977	5.48
		1978	5.48

Source: The formulas for deriving these numbers are provided in Michael L. Wachter, "The Changing Cyclical Responsiveness of Wage Inflation Over The Postwar Period," Brookings Papers on Economic Activity (1:1976), pp. 115-159. The equations have all been updated to include the latest data. Since the basic model is reestimated, the resulting U_N series may differ slightly from the U_N figures presented in the above-cited paper.

Table 3

Noninflationary Rate of Unemployment, Selected Years 1955-1978

	1955	1965	1975	1978
Males				
16-19	10.7	13.5	15.2	15.1
20-24	6.3	7.3	8.0	7.9
25-34	3.0	3.4	3.6	3.6
35-44	2.7	2.6	2.5	2.5
45-54	3.1	2.7	2.5	2.5
55-64	3.6	3.1	2.8	2.8
65+	3.6	3.6	3.6	3.6
Females				
16-19	9.8	13.8	16.7	16.5
20-24	5.6	7.6	9.0	8.9
25-34	4.7	5.7	6.2	6.2
35-44	3.8	4.3	4.7	4.6
45-54	3.3	3.5	3.7	3.7
55-64	3.3	3.2	3.1	3.1
65+	2.4	3.1	3.4	3.5

Source: Michael L. Wachter, "The Demographic Impact on Unemployment: Past Experience and Outlook for the Future," Demographic Trends and Full Employment. A special report of the National Commission for Manpower Policy, Special Report No. 12, December 1976, pp. 27-99. The calculations have been updated to include data through 1978.

Appendix to Section III

Model Validation

Statistically measuring the accuracy of "goodness-of-fit" of a large simultaneous system of equations is generally difficult. With no determinant measures available we must fall back on rule of thumb estimates of validity in order to conclude that a model closely replicates historical behavior. Our current technique for approaching this problem is to examine the model in the context of historical simulation, multiplier analysis and forecasting results.

The initial tests with the labor force model involved historic simulations over the period from 1963 through 1976. Error statistics for the dynamic simulation appear in Table 3A. These simulations were "dynamic" in the sense that, although actual values were used for all periods prior to 1963, solution values were used for all periods thereafter. For the variables that are exogenous to the labor force model actual historical values were used. While the model could have been simulated and incorporated into the fully endogenous macromodel, following such a procedure would prevent fully identifying which errors originate in the labor force model and which errors are caused by incorrectly estimated macroeconomic quantities that are inputs into the labor force model. Therefore, the historical simulation was run with the inputs from the macromodel fixed at their historical values.

Table 3A

Wharton Annual Labor Force Model; School Enrollment Rates and Labor Force Participation Rates in Historical Simulation, 1963-1976

Variable Name[1]	MAE (Fraction)	MAPE (Percent)	RMSR (Fraction)	RMSPE (Percent)
School Enrollment Rates				
NPSM16.17	0.046	1.35	0.057	1.70
NPSM18.19	0.087	4.92	0.100	5.60
NPSM20.24	0.060	3.41	0.075	4.45
NPSF16.19	0.139	3.06	0.161	3.61
NPSF20.24	0.036	2.95	0.061	4.44
Labor Force Participation Rates				
NRLTM16.19	0.0162	2.94	0.0195	3.62
NRLTM20.24	0.0043	0.51	0.0048	0.57
NRLTM25.34	0.0015	0.15	0.0017	0.18
NRLTM35.44	0.0015	0.16	0.0018	0.18
NRLTM45.54	0.0022	0.24	0.0030	0.32
NRLTM55.64	0.0106	1.31	0.0118	1.48
NRLTM65+	0.0079	3.13	0.0085	3.34
NRLTF16.19	0.0136	3.11	0.0165	3.74
NRLTF20.24	0.0072	1.28	0.0086	1.51
NRLTF25.34	0.0134	2.88	0.0170	3.50
NRLTF35.44	0.0039	0.75	0.0047	0.89
NTLTF45.54	0.0073	1.38	0.0090	1.88
NRLTF55.64	0.0051	1.22	0.0063	1.52
NRLTF65+	0.0030	3.25	0.0034	3.68

[1] For a translation of mnemonics, See Appendix II.

NOTES:

MAE = Mean Absolute Error
MAPE = Mean Absolute Percentage Error
RMSE = Root Mean Square Error
RMSPE = Root Mean Square Percentage Error

Four measures of error are reported in Table 3B.

1) MAE = Mean Absolute Error

$$\sum_{t=1}^{N} (|P_t - A_t|)/N$$

where

A_t = actual

P_t = predicted or simulated value

N = number of solution periods

2) MAPE = Mean Absolute Percentage Error

$$\sum_{t=1}^{N} (|(P_t - A_t)/A_t| * 100.)/N$$

3) RMSE = Root Mean Square Error

$$(\sum_{t=1} (P_t - A_t)^2/N)^{1/2}$$

4) RMSPE = Root Mean Square Percentage Error

$$(\sum_{t=1} ((P_t - A_t)^2/N))^{1/2} * 100$$

while alternative measures of error are available, the above measures are easily comparable, serve our purposes, and are unlikely to give misleading indications of the accuracy of the model.

On the whole, these statistics are acceptable (see Tables 3A, and 3B). Although certain variables are simulated with less accuracy than others, the central model variables - the prime age unemployment rates and participation rates for example - show remarkable precision. Indeed, of the labor force

Table 3B

Wharton Annual Labor Force Model; Unemployment
Rates in Historical Simulation
1963 to 1976

Variable Name[1]	MAE (Fraction)	MAPE (Percent)	RMSE (Fraction)	RMSPE (Percent)
NRUTM16.19	1.381	8.96	1.626	10.25
NRUTM20.24	1.182	15.63	1.381	18.07
NRUTM25.34	0.756	21.15	1.062	27.20
NRUTM35.44	0.427	16.37	0.554	20.47
NRUTM45.54	0.390	15.43	0.481	19.52
NRUTM55.64	0.466	16.59	0.583	21.30
NRUTM65 +	0.480	13.11	0.634	16.56
NRUTF16.19	1.217	7.36	1.623	9.70
NRUTF20.24	0.801	8.92	0.969	10.25
NRUTF25.34	0.599	9.37	0.739	10.71
NRUTF35.44	0.469	9.76	0.589	11.63
NRUTF45.54	0.393	10.28	0.564	14.14
NRUTF55.64	0.448	13.73	0.572	16.01
NRUTF65+	0.333	9.20	0.463	11.81

[1] For a translation of mnemonics, see Appendix II.

NOTES:

MAE = Mean Absolute Error
MAPE = Mean Absolute Percentage Error
RMSE = Root Mean Square Error
RMSPE = Root Mean Square Percentage Error

participation rate equations, the three prime-age male rate equations are the most accurate. The 20 to 40 year old group equations fall in the same range of precision; the root mean square percentage error is 0.57% compared with 0.37% for the 45 to 54 year old group and 0.18% for both the 25 to 34 year-old and the 35 to 44 year old groups. Compared to these, all the female age groups and the younger and older male age groups are in a less accurate range, but the root mean square percentage error for these variables is at most 3.7%.

Among the unemployment rates there seems to be a reversed relationship between accuracy and the age-sex group. The equations for female groups are in all cases more accurate than the male equation for that age group. A plausible explanation for this observation may rest with the fact that the female unemployment rates appear more stable than the corresponding male rates and/or are more uniformly related to the explanatory variables. There is also some difference in the age pattern of the error measures. For the male unemployment rate equations, the groups from 20 to 64 years of age all show root mean square percent errors of about 20% (except for 25 to 34 year-old group), whereas for the female equations this statistic is almost linearly related to age group: the older the group, the larger the error term.

Overall the statistics compare quite favorably with similar statistics for other disaggregated sectors of the macromodel. Therefore, we are confident that we have installed a relatively dependable model of labor force behavior.

IV. THE MILITARY ENLISTMENT MODEL

A quarterly enlistment model was estimated as part of the second year research project for the Office of Naval Research. The equations are preliminary and have not yet been incorporated into the Wharton model.

Time series data, for the period 1955 to 1977, were used to estimate enlistment equations for both the Navy and the Department of Defense (DOD). On the basis of the estimated equations, an attempt was made to identify the determinants of enlistment behavior. The format of this section is as follows: In the first section, the basic hypotheses of the study and issues concerning the economic viability of the All-Volunteer Armed Forces system are introduced. The specification of the model is discussed in the second section. Empirical results are presented in the third section. For a detailed discussion of the research underlying this section, see Kim (1979).

A. Introduction

During the late 1960's, the government initiated research on projects to determine the feasibility of shifting to an All-Volunteer Armed Forces system. These studies generated some useful enlistment equations. The focus of the studies was primarily on isolating the relationship between relative expected earnings and military enlistment rates. In addition, there were attempts to find a causal link between unemployment and enlistment rates.

The results of these studies indicated a significant and elastic relative pay effect. The elasticities generally ranged between 1.0 and 2.5. These studies were unsuccessful, however, in establishing a relationship between civilian labor market conditions (i.e. unemployment rates) and military enlistment rates. Moreover, little stress was placed on the impact of demographic variables such as RPY. As indicated in the WEFA model, demographic variables are particularly important in a period of dramatic changes in the age-structure of the population. They are central to estimates of the quantitative magnitude of the competition between the civilian and military sectors as the baby boom cohort is replaced by the baby bust cohort.

Statistics to date suggest that the AVF system has been functioning satisfactorily. Even the Army, which has experienced occassional difficulties in recruiting, has been able to meet its desired quotas. Total enlistments as a percentage of objectives (quotas), for example, were 100.6, 102.1, 100.2 and 99.2 for the

fiscal years 1974, 1975, 1976 and 1977 respectively. Moreover, the data for non-prior service (NPS) males displayed an improvement over time. During the same period, the NPS males enlistments as a percentage of objectives were 97.8, 98.8, 100.1 and 100.3 respectively.

It is possible, however, that the present successes of the AVF system might be due to loose labor market conditions and the availability of a large cohort in the 18-24 age group. The adoption of the AVF coincided with the entrance of the baby boom cohort into the labor market. As discussed above, the demographic shift toward a younger work force resulted in an increase in the pool of structurally unemployed youth and a reduction in their relative wages. In addition, these developments coincided with a reduction in the size of the military forces due to the end of the Vietnam War and a rise in cyclical unemployment rates. But with the baby boom cohort slowly being replaced by the baby bust cohort, in the relevant age groups for enlistments, the future success of the AVF system in fulling military quotas should be reexamined.

In analyzing the future potential problems in enlistments, two basic hypotheses are tested. The first is that equal percentage increases in military and civilian pay results in a decreasing enlistment rate; that is, the military as an occupation is "inferior," on average, to civilian jobs. In this case, to maintain a steady enlistment rate, the increase in military pay must exceed the increase in civilian pay. This hypothesis was stressed in the Gates Commission report.

A second hypothesis is that enlistees come primarily from the structual unemployment pool, that is, the U_N group. The cyclical unemployment pool might not be relevant to enlistments because of the short-run nature of the business cycle downturn relative to the enlistment period. For example, it is doubtful that the above-average quality youth, who is on layoff due to a cyclical downswing, will enlist when the military pay is far below civilian pay.

The successful introduction of the U_N variable into the enlistment equation has important implications. As discussed above, the U_N variable basically represents the demographic adjusted full-employment rate. A significant relationship between U_N and enlistment rates indicates that desired manpower requirements can currently be met relatively easily due to the high U_N. On the other hand, as the smaller baby bust cohort enters the labor market and U_N declines it will be more difficult to achieve the desired manpower strength.

B. The Enlistment Equation

Previous enlistment studies have focused on supply side estimates of enlistment rates while virtually ignoring demand side conditions. The dependent variable is often limited to high mental category enlistees and it is generally assumed that the number accepted reflect supply conditions.

In the future, however, the military may find it increasingly difficult to fulfill its quotas while maintaining the same high quality standards. If quotas are to be satisfied, it may become necessary to admit a higher percentage of lower mental category enlistees. In this case, the percentage of enlistees in the low quality category depends upon desired manpower requirements (demand-side conditions) as well as the relative supply of high quality enlistees.

For illustrative purposes, suppose that there are two different enlistment supplies; E^s_h and E^s_l, where E represents the number of enlistments, the superscript s denotes supply, and the subscripts h and l represent high quality and low quality enlistees respectively. Furthermore, suppose that E^d represents the demand for enlistees subject to an allotted quota Q. The desired manpower quota is decided by exogenous factors such as international crises. The model can be written:

(1) $E^s_h = f(Y, X_i)$

(2) $E^s_l = f(Y, X_j)$

(3) $E^d = f(Y, Z_i; Q)$

where Y represents the military pay relative to civilian pay X_i, X_j, and Z_i, represent other right hand side variables (such as draft pressure and civilian labor market conditions) and Q denotes the "objective" or quota. The aggregate supply be written as the sum of (1) and (2)

$$(4) \quad E^s = E^s_h + E^s_l = g(Y,X)$$

Figure 1 illustrates the demand and supply curves for enlistees. If the recruiters want only quality enlistees and there is no binding quota constraint, the equilibrium number of enlistees will occur at N_1. If the quota (Q) is greater than N_1, then the military will recruit up to N_0 in order to achieve Q (thus, $Q = N_0$). This amount, $N_0 - N_1$, is the number of lower quality enlistees and it can be used as a proxy for excess demand.

The aggregate enlistment rate equation is assumed to have the following form:

(6) ENL = F(MP, CP, U, DRP, q)

where, ENL = enlistment rate, number of enlistees divided by the relevant population

MP = expected military earnings

CP = expected civilian earnings

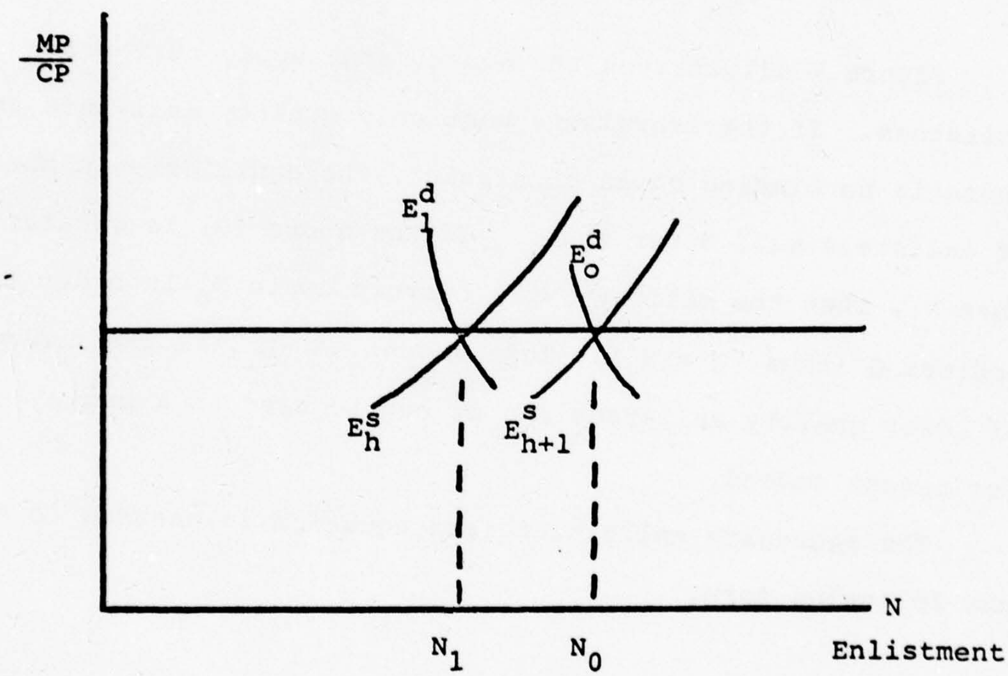
U = a measure of youth unemployment

DRP = a measure of draft pressure, the number of inductees divided by the relevant population

q = a measure of quality as a proxy for the demand pressure.

Figure 1

Enlistment Supply and Demand



N_o: Equilibrium enlistment

N_1: High quality enlistments only

E_l^s: Supply curve of low quality enlistees

E_{h+1}^s: Supply curve of both high and low quality enlistees

The expected relationship between the independent variables and the enlistment rates are examined below.

It is assumed that a utility-maximizing individual compares the different earnings streams when deciding whether or not to enlist, other variables held constant. For example, let $W_{M1} \ldots W_{MK}$ denote the expected earnings during service in the military and $W_{C1} \ldots W_{CK}$ the expected earnings in the civilian economy. In making the decision whether or not to enlist, an individual compares the present discounted value (PDV) of the enlistee's expected earning with those of civilian earnings for his life-cycle. Suppose that n represents an individual's expected life-time working period. Then the PDV of the expected earnings for the potential enlistee and for the non-enlistee can be expressed as follows:

$$PDV_M = \sum^{k} \frac{W_{M_i}}{(1+r)^i} + \sum_{i=k+1}^{n} \frac{W_{M_i}}{(1+r)^i}$$

$$PDV_C = \sum_{i=1}^{k} \frac{W_{C_i}}{(1+r)^i} + \sum_{i=k+1}^{n} \frac{W_{C_i}}{(1+r)^i}$$

where r denotes an individual's discount rate, k represents the time period of military service, and W_{M_i} is the enlistee's expected earnings in the civilian economy after retiring from the military, from the (k+1) period to the n^{th} period. Evidence indicates that there is little difference between a veteran's

and a nonveteran's earnings. That is, the second terms of PDV_M and PDV_C are approximately the same. Therefore, an individual is assumed to enlist if:

$$PDV_M = \sum_{i=1}^{k} \frac{W_{M_i}}{(1+r)^i} > PDV_C = \sum_{i=1}^{k} \frac{W_{C_i}}{(1+r)^i}$$

Thus, the theory predicts that, ceteris paribus, MP is positively related to enlistment rates, while CP is negatively related to enlistment rates.

Second, since periods of unemployment reduce PDV_C, unemployment is assumed to be positively related to enlistment. It should be stressed again that in this study the U_N figure is used rather than the BLS unemployment measure.

The third relevant exogenous variable, which represents some of the demand side conditions affecting enlistment, is the draft pressure variable (DRP). During the years when the military draft was operating increases in the quota were automatically satisfied. Since enlistees were the first to be accepted into the military, the higher DRP, the greater the number of enlistees accepted. The DRP variable is also assumed to have a positive impact on enlistment supply. First, employers in the civilian labor market are likely to prefer hiring individuals who are more certain to remain on the job than potential draftees. Second, an enlistee can choose his preferred service and reduce the probability of being assigned to combat forces.

The fourth independent variable, the quality variable, also represents demand pressures. As indicated in the diagram above, the percentage of enlistees who are in the lower mental category, is a reflection of excess demand factors.

C. Empirical Results

The estimated equation is of the following form:

$$\ln \frac{(ENL)}{1-ENL} = F(MP, CP, S1, S2, S3, (1-DRP), LTDUM, q);$$

where MP and CP represent expected military earnings and civilian earnings respectively, S1, S2, and S3 denote seasonal dummies, DRP is a measure of the probability of being drafted, LTDUM is a dummy for the lottery period, and q is a measure of the quality of acceptable enlistees. The sample period was from 1955:1 through 1977:2. For estimation purposes the logit functional form was adopted primarily because it constrains the dependent variable (the enlistment rate) to the unit interval and exhibits a variable elasticity. Intuitively, if the military pay (MP) is far below the civilian pay (CP), a small increase in MP is not expected to greatly affect enlistments. But if MP is at an equivalent level with CP, then the increase in MP will have more of an impact. In other words, the elasticity is expected to be small when MP is very low but high when MP is approximately equal to CP.

Empirical studies were made for both the DOD and the Navy. In developing an integrated Navy recruitment economic model, it might be useful to estimate the military equations at the DOD level and then use "share" equations for the different branches of the armed services. These issues should be explored in future research.

Due to changes in the status of the draft, our approach was to test for a structural shift in (approximately) 1973. Equations were estimated for three different periods, pre-1973, post 1973, and the combined period. The derived Chow-statistics clearly imply that the estimated parameters do not belong to the same regression model and thus suggest the occurrence of a structural shift. These test were made for both DOD and Navy enlistment equations and the results of both equations confirmed that a structural shift had occurred. As a result, the equations are estimated for two periods, with 1973 as dividing point.

The empirical results are presented in Tables 4 through 7. The two major findings can be summarized as follows. First, the U_N variable (UN19M) consistently showed significant coefficients with a correct sign. On the other hand, for the equations where the BLS unemployment rate for male youth (UR19M) was used instead of UN19M, UR19M was insignificant, often with an incorrect sign. Furthermore, UN19M was more significant for DOD equations than for the Navy equations. As was pointed out in the earlier section, the success of the U_N variable supports the hypothesis that the cyclical unemployment pool is not the relevant source of enlistment and that the fulfillment of desired manpower strength during the AVF may have been partically due to the high value of U_N over the past decade.

Table 4

Basic Enlistment Rate Equations for DOD

Equations	1	2	3	4	5
Est Period	1955:01 -1972:04	1973:01 -1977:03	1955:01 -1972:04	1973:01 -1977:03	1973:01 -1977:03
Constant	-3.4303 (-12.45)	-1.7723 (-1.50)	-3.0266 (-10.40)	-2.5841 (-1.98)	-17.1261 (-1.99)
MP (*100)	.0340 (.16)	1.4167 (3.41)	.0478 (.24)	2.3495 (2.88)	2.0207 (3.96)
CP (*100)	-.9061 (-2.68)	-4.5416 (-4.20)	-.8422 (-2.64)	-.0526 (-4.43)	-4.2043 (-4.13)
S1	.1662 (2.39)	.0449 (1.14)	.1639 (2.50)	.0277 (.68)	.0416 (1.14)
S2	.0590 (.85)	.0700 (1.83)	.0587 (.90)	.0771 (2.05)	.0805 (2.24)
S3	.3452 (4.96)	.3414 (8.29)	.3457 (5.28)	.3744 (7.91)	.3661 (9.04)
UR19M			-.0336 (-3.08)	.0145 (1.31)	
UN19M					.9280 (1.79)
q					
$\bar{R}^2$	.324	.832	.401	.841	.856
DW	.410	2.433	.496	2.662	2.914

Table 5

Enlistment Equations for DOD, 1955:1 - 1972:4

Equations	1	2	3	4	5
Constant	23.0138	14.4756	11.4625	12.2036	13.0596
	(5.05)	(2.85)	(2.01)	(2.12)	(2.28)
MP	.6234	.5959	.4396	.3071	.2244
(*100)	(3.22)	(3.23)	(1.94)	(1.43)	(1.02)
CP	-.5954	-5.7129	-4.1143	-.5392	-.5679
(*100)	(-2.21)	(-3.43)	(-1.90)	(-2.11)	(-2.23)
S1	.1669	.1702	.1726	.1735	.1754
	(3.36)	(3.65)	(3.71)	(3.68)	(3.76)
S2	.0827	.0768	.0754	.0766	.0771
	(1.67)	(1.65)	(1.62)	(1.62)	(1.65)
S3	.3563	.3511	.3490	.3493	.3472
	(7.19)	(7.54)	(7.51)	(7.41)	(7.44)
UR19M					.0163
					(1.52)
UN19M		.3254	.2256		
		(3.11)	(1.66)		
q			.7979	1.5317	2.0265
			(1.15)	(2.84)	(3.24)
LTDUM	-.2355	-.2975	-.3023	-.2812	-.2880
	(-2.85)	(-3.71)	(-3.77)	(-3.51)	(-3.62)
(1-DRP)	-.2750	-.1814	-.1531	-.1655	-.1761
	(-6.07)	(-3.48)	(-2.66)	(-2.86)	(-3.06)
$\bar{R}^2$	.658	.698	.700	.691	1.024
DW	1.002	.962	.945	.955	1.024

Table 6

Basic Enlistment Rate Equations for Navy

Equation	1	2	3	4	5
Est. Period	1955:01 -1972:04	1973:01 -1977:03	1955:01 -1972:04	1973:01 -1977:03	1955:01 -1972:04
Constant	-3.7935 (-12.00)	-.4719 (-.23)	-3.4378 (-10.01)	-.2957 (-.13)	-2.8172 (-5.93)
MP (*100)	.0947 (.137)	1.5518 (2.11)	.0980 (.40)	1.3459 (.88)	.0323 (.13)
CP (*100)	-2.0391 (-5.20)	-7.2276 (-3.82)	-1.9755 (-5.19)	-7.0696 (-3.19)	-8.0263 (-3.52)
S1	.1713 (2.15)	-.0983 (-1.42)	.1694 (2.19)	-.0944 (-1.25)	.1705 (2.23)
S2	.0700 (.88)	.0004 (.01)	.0697 (.90)	-.0011 (-.02)	.0667 (.87)
S3	.4061 (5.09)	.4411 (6.13)	.4064 (5.26)	.4340 (4.93)	.3993 (5.23)
UR19M			-.0295 (-2.29)	-.0032 (-.15)	
UN19M					.3742 (2.66)
q					
$\bar{R}^2$	.469	.813	.501	.797	.514
DW	.995	2.288	1.093	2.327	1.108

Table 6
Continued

Equation	6	7	8
Est. Period	1973:01 -1972:04	1955:01 -1972:04	1973:01 -1977:03
Constant	-22.6255 (-1.44)	-3.9749 (-13.35)	3.1653 (.55)
MP (*100)	2.4311 (2.59)	-.6969 (-2.12)	2.2435 (1.76)
CP (*100)	-6.7420 (-3.64)	-1.3356 (-3.20)	-11.4427 (-1.75)
S1	-.1033 (-1.55)	.1813 (2.45)	-.111 (-1.52)
S2	.0151 (.23)	.0794 (1.07)	.0112 (.16)
S3	.4763 (6.47)	.4072 (5.51)	.4523 (6.00)
UR19M			
UN19M	1.3393 (1.42)		
q		2.1194 (3.44)	-1.4765 (-.67)
$\bar{R}^2$	.826	.544	.804
DW	2.369	1.191	2.349

Table 7

Enlistment Equations for Navy, 1955:1 - 1972:4

Equation	1	2	3	4	5	6
Est. Period	1955:01 -1972:04	1955:01 -1972:04	1955:01 -1972:04	1955:01 -1972:04	1955:01 -1972:04	1955:01 -1972:04
Constant	15.9740 (2.63)	11.1448 (1.55)	8.5898 (1.21)	9.2124 (1.43)	7.9729 (1.08)	15.2388 (2.17)
MP (*100)	.7785 (2.92)	.7584 (2.85)	.2532 (.72)	.2333 (.69)	.2222 (.65)	.7743 (2.88)
CP (*100)	-1.6122 (-4.49)	-4.5149 (-1.92)	-1.6574 (-.62)	-1.0830 (-2.67)	-1.0656 (-2.59)	-1.6040 (-4.41)
S1	.1759 (2.66)	.1777 (2.70)	.1851 (2.89)	.1852 (2.91)	.1853 (2.89)	.1759 (2.64)
S2	.0929 (1.41)	.0895 (1.36)	.0957 (1.50)	.0967 (1.52)	.0961 (1.50)	.0925 (1.39)
S3	.4187 (6.35)	.4157 (6.32)	.4189 (6.54)	.4195 (6.61)	.4195 (6.56)	.4187 (6.30)
					-.0045 (-.35)	-.0028 (-.21)
UR19M		.1846 (1.25)	.0351 (.22)			
q			1.3844 (2.11)	1.4475 (2.48)	1.4588 (2.48)	
LTDUM	-.3240 (-2.92)	-.3581 (-3.14)	-.3606 (-3.25)	-.3555 (-3.30)	-.3576 (-3.29)	-.3152 (-2.90)
(1-DRP)	-.2096 (-3.47)	-.1566 (-2.13)	-.1359 (-1.88)	-.1431 (-2.24)	-.1300 (-1.75)	-.2018 (-2.84)
$\bar{R}^2$	.637	.640	.659	.664	.660	.632
DW	1.590	1.601	1.723	1.731	1.728	1.587

Second, the coefficients indicate that civilian pay elasticities are consistently higher than military pay elasticities. This implies that an equal percentage increase in military and civilian pay would result in a decreasing enlistment rate. In other words, in order to maintain steady enlistment rates, the military wage has to increase faster than the civilian wage.

V. PROJECTIONS 1985

Although the military equations have not been integrated into the overall WEFA model, it may be useful to look ahead to some of those issues which were to be analyzed in the third year of the ONR project. Of particular interest are supply and demand projections to 1985 in terms of their implications for the availability of young males for the AVF.

A. Labor Supply Projections

Without the third year research, it is necessary to use OLS estimates of the labor supply equations. The forecasts were derived by Wachter (1980). Labor supply forecasts derived from the annual WEFA model are discussed in the appendix to this chapter. The two sets of forecasts are largely the same and may be viewed as interchangeable for the expositional purposes of this section. Future work, for example, on the projected dollar cost of the AVF in the baby bust period would be based on the WEFA model.

Any forecast of the future is, of course, dependent upon changes in the underlying environment. More specifically, the forecasts of the labor supply depend upon how the explanatory variables are assumed to change between the current period and 1985-1990. To simplify the projections a trend variable was substituted for the wage and income variables used in the WEFA equations. Hence, the future movements of two key variables are known. The trend variable increases along the predetermined

trend rate of growth. In addition, the relative cohort size variable, RPY, is given by the official U.S. population projections.

For the remaining variables, it is assumed that: (1) unemployment remains at full-employment (2) school enrollment rates recover from their current low levels and return close to their previous peak rates; (3) the armed forces remain a constant percentage of the population; and (4) the current fertility rate increases to the zero population growth level in 1981 and remains constant thereafter. The labor force participation rates, projected for 1985 and 1990, are shown in Table 8. As can be seen, this set of assumptions provides the "optimistic" forecast of the participation rates for males 16-19.

The number of workers in each of the fourteen age-sex groups is determined by multiplying the appropriate participation rate by each age-sex segment of the population. The resulting figures are shown in Table 9. The annualized rates of labor force growth, for the various age-sex categories, between 1970-1977, 1977-1985, and 1985-1990 are given in Table 10.

The central developments projected for the labor markets of the 1980-1990 period are depicted clearly in Table 10. In the 1970-1977 period, the labor force grew rapidly for males 16 to 24 and females 16 to 34. This was the result of the passage of the baby boom cohort through that age group and the associated increase in female participation rates. For the 1980 to 1985 period, the baby boom group begins to enter the 25 to 44 age

Table 8

Labor Force Participation Rates

By Age-Sex Group
(Percent)

	Actual Rates		Projected Rates	
Age-Sex	1970	1977	1985	1990
MALE				
16-19	56.0	59.9	69.1	72.0
20-24	82.8	85.3	84.6	84.5
25-34	96.4	95.1	95.8	96.5
35-44	96.7	95.4	95.6	95.7
45-54	94.1	91.2	90.1	90.4
55-64	82.1	83.7	72.0	72.8
65+	26.0	19.8	16.2	13.6
FEMALE				
16-19	43.3	50.9	61.3	66.7
20-24	57.2	65.9	69.8	70.9
25-34	45.3	58.8	65.4	68.8
35-44	50.9	59.0	68.1	70.1
45-54	54.0	55.3	61.9	68.7
55-64	42.9	40.7	45.4	51.7
65+	9.5	8.1	8.2	8.7

Source: The projections are calculated from updated versions of the labor force participation equations described in Wachter (1977).

Table 9

Civilian Labor Force

1970 to 1990
Actual and Projected Levels

	Actual Levels		Projected Levels	
	1970	1977	1985	1990
MALE				
16-19	4005	4987	4751	4665
20-24	5709	7872	7952	6883
25-34	11311	14886	18130	18834
35-44	10464	10618	14281	16753
45-54	7124	7042	7345	7172
65+	2164	1862	1720	1584
Male Total	51195	57418	63893	66874
FEMALE				
16-19	3241	4268	4302	4402
20-24	4874	6555	7037	6255
25-34	5968	9850	13018	14136
35-44	5967	7153	10868	13022
45-54	6531	6697	7118	8899
55-64	4153	4367	5124	5548
65+	1056	1065	1258	1466
Female Total	31520	39955	48725	53728
TOTAL	82715	97373	112618	120602

Source: The actual data for 1970 and 1977 are from Employment and Earnings, Bureau of Labor Statistics. The projected levels are derived by the author. The methodology is discussed in the text and in Wachter (1977).

Table 10 .

Compounded Annual Rates of Change
for the Civilian Labor Force

	1970-1977	1977-1985	1985-1990
MALE			
16-19	3.18	-0.60	-0.36
20-24	4.70	0.13	-2.85
25-34	4.00	2.49	0.76
35-44	0.21	3.77	3.24
45-54	-0.32	-0.59	2.49
55-64	-0.17	0.53	-0.48
65+	-2.40	-0.74	-1.63
Male Total	1.65	1.34	0.92
FEMALE			
16-19	4.01	0.10	0.46
20-24	4.32	0.89	-2.33
25-34	7.42	3.55	1.66
35-44	2.62	5.37	3.68
45-54	0.63	0.77	4.57
55-64	0.72	2.02	1.60
65+	0.12	2.10	3.11
Female Total	3.44	2.51	1.97
TOTAL	2.36	1.83	1.38

Source: Based on data of Table 9

categories which will result in these categories having the largest growth rates. By the 1985-1990 period, the absolute number of young workers, age 16-24, will decline significantly. The major growth occurs in the 35 to 54 age categories. These shifts in growth rates result largely from the movement of the baby boom into the older age groups and its replacement by the baby bust cohort in the younger working age groups. The higher growth rate for older female workers is due to projected increases in their participation rates. That is, the baby boom females continue their pattern of high labor force participation rates. On the other hand, the baby bust cohort is likely to have participation rates approximately equal to or only slightly above those of the preceding baby boom cohort.

The major conclusion of the labor supply analysis is that, by 1985-1990, the number of young workers in the labor force will be declining. Moreover, the growth rate in the number of lower skilled females will fall as their participation rates level off. Since these females are close substitutes for young males in many civilian jobs, the labor supply available to the military is reduced still further. Comparing 1970-1977 with 1985-1990 indicates a demographic transition of immense proportions. The changing outlook for Navy recruitment in a AVF environment is largely a function of this twist in the demographic age structure of the labor force.

B. Labor Demand Projections

The demand projections for 1985, used in this paper, are based on the official Bureau of Labor Statistics calculations. Their projected employment figures by occupation for 1985 are shown in Table 11. They indicate a continuation in the shift toward white collar (except sales) and service workers (except private household workers) and away from blue collar workers.

In analyzing the labor demand projections provided by the BLS, it should be understood that they can only be used as a point of departure. Predicting the future is always hazardous, and this has been particularly the case with respect to occupational manpower needs. The construction of alternative scenarios by the Bureau of Labor Statistics (for both labor supply and demand) emphasizes that these calculations of the future are highly tentative. These labor supply and demand projections are not used as actual numerical forecasts of the future, but rather as developments which might occur in the absence of any change in exogenous variables and in the absence of market clearing adjustments in general.

In projecting occupational employment, the BLS methodology can be divided into two steps. The first step is to determine the level of overall employment. Since the BLS makes labor force supply projections, they utilize these labor force numbers as a constraint on total or <u>aggregate</u> employment. To determine the level of employment, given the labor force, the BLS assumes

Table 11

Projected Requirements and Job Openings for Major Occupational Groups, 1974-1985

Occupational group	1974 Employment	Projected 1985 Requirements	Percent Change
Total.......	85,936	103,400	20.3
White-collar workers	41,739	53,200	27.5
Professional and technical workers	12,338	16,000	29.4
Managers and administrators	8,941	10,900	21.6
Salesworkers.....	5,417	6,300	15.7
Clerical workers....	15,043	20,100	33.8
Blue-collar workers	29,776	33,700	13.2
Craft and kindred workers......	11,477	13,800	19.9
Operatives......	13,919	15,200	9.0
Nonfarm Laborers	4,380	4,800	8.8
Service workers.....	11,373	14,600	28.0
Private household workers......	1,228	900	-26.7
Other service workers.....	10,145	13,700	34.7
Farm workers......	3,048	1,900	-39.0

Note: Details may not add to totals because of rounding. Percentages were calculated using unrounded numbers.

Source: Max L. Carey, "Revised Occupational Projections to 1985." Monthly Labor Review (November, 1976), pp 10-22.

that in 1985, the economy is at full-employment when there is a 4 percent unemployment rate.

The second step is to divide the level of employment among the occupational categories. Projecting the relative growth of the various occupations is done largely on the basis of a trend and autoregressive extension of present levels or relative occupational employment. For example, occupations that have been growing very rapidly over the past three years will be projected to show continuing rapid growth but at a somewhat lower level. Other factors also enter the calculations, but projecting recent growth rates into the future is the single most important element.

The approach of this section is to compare the 1985 BLS occupational projections with the labor supply projections for the same year. In adopting this strategy, the BLS occupational projections are labeled as determined by demand factors whereas the participation or labor force projections are determined by supply factors. The fact that the BLS constrains total employment in their occupational projections to conform to their own labor supply estimates does not comprise the notion that the model is demand driven. The BLS occupational projections may be viewed as demand oriented because the <u>relative</u> employment by occupation is determined by demand factors without (or with little) regard to the likely age-sex composition of the labor force in 1985.

The labor supply projections may be viewed as supply oriented because the age-sex composition of the labor force is determined

without regard for demand factors related to the occupational structure.

In order to compare the demand and supply oriented models, it is useful to assume that the age-sex requirements of a job are rigid. This is adopted as an expositional device because it yields the maximum potential forecast differences between the two models. The purpose is to isolate the areas where discrepancies are likely to arise. As a consequence, no attempt is made to forecast the final age-sex composition of occuaptions that should result in 1985 after market forces adjust to equilibrate supply and demand.

Due to data availability from the Census, the age-sex requirements of an occupation are frozen at their 1970 level. For purposes of notation, ΣOM_{ij} refers to the occupational mix for occupation i for the fourteen age-sex groups indexed on j.

In Table 12, column 1 presents the 1970 occupational mix. Column 2 shows the occupational distribution in 1985 according to the demand projections. These figures are determined by multiplying the BLS demand projections for each of the nine occupational groups by the ratio of employment in each age-sex group to total employment, for each occupation. In terms of the occupational mix matrix, this ratio is $(OM_{ij}/\Sigma OM_{ij})$. This yields the age-sex breakdown for each occupation. Total employment is obtained by summing over the occupational groups for each age-sex group.

Column 3 of Table 12 indicates the occupational distribution based on the Table 8 age-sex labor force supply projections for

Table 12

Relative Employment By Occupation
1985 Projections

Occupation Group	1970	BLS Occupational Demand Model	Labor Supply Model
Professional and Technical Workers	14.836	15.097	15.498
Managers and Administrators Except Farm	8.322	10.806	7.577
Sales Workers	7.123	6.208	6.974
Clerical Workers	17.959	19.204	19.654
Craft and Kindred Workers	13.868	13.141	12.806
Operatives	17.539	14.962	17.498
Non-Farm Laborers	4.492	4.610	4.278
Service Workers	12.762	14.190	13.079
Farmers and Farm Laborers	3.085	1.782	2.675
TOTAL	100.00	100.00	100.00

Source: Wachter, Michael L., "The Labor Market Mechanism and Immigration: The Outlook for the 1980's," Prepared for the Interagency Task Force on Immigration, Industrial Labor Relations Review, forthcoming 1980.

1985. These latter figures are determined by multiplying the supply projections for each of the 14 age-sex demographic groups by the ratio of each occupation to total employment, for each demographic group. This yields the occupational breakdown for each age-sex group. Total employment is then obtained by summing over the demographic groups for each occupation.

Table 13 presents the 1985 projections including a sex breakdown by occupation. Columns 1 and 2 indicate the male and female occupational or demand projections as calculated by the Bureau of Labor Statistics. Column 3 and 4 indicate the labor force or supply projections of Table 8 allocated across occupations using ΣOM_{ij}.

As would be expected, the demand driven model, using 1970 age-sex occupational requirements, indicates a larger need for male workers than is available from the labor supply projections. Specifically, the BLS occupational mix, projected to 1985, needs a labor force that is 61.2 percent male. The labor projections, however, suggest a labor force which is only 57.1 percent male.

Comparing the supply and demand projections of Table 13 for the blue-collar trades illustrates the potential shortage of male craft, nonfarm laborers, and service workers. For example, the demand model indicates that 5.6 percent of the work force should be service workers, but the supply model only provides 4.5 percent of the work force for these jobs. Adding together the nonfarm laborers and service workers, on average

Table 13

Relative Employment by Occupation and Sex
1985 Projections

Occupation Group	BLS Occupational Demand Model Male	BLS Occupational Demand Model Female	Labor Supply Model Male	Labor Supply Model Female
Professional and Technical Workers	9.046	6.051	8.477	7.011
Managers and Administrators Except Farm	9.016	1.789	6.106	1.471
Sales Workers	3.766	2.441	3.927	3.037
Clerical Workers	5.087	14.117	4.417	15.238
Craft and Kindred Workers	12.493	0.648	12.035	0.762
Operatives	10.343	4.619	11.334	6.164
NonFarm Laborers	4.230	0.381	3.847	0.422
Service Workers	5.622	8.568	4.541	8.538
Farmers and Farm Laborers	1.615	0.167	2.380	0.321
TOTAL	61.218	38.782	57.109	42.964

Source: Wachter, Michael L., "The Labor Market Mechanism and Immigration: The Outlook for the 1980's," Prepared for the Interagency Task Force on Immigration, Industrial Labor Relations Review, forthcoming 1980.

the least skilled occupations, yields a demand for 9.85 percent male workers and a supply of 8.39 percent; hence a shortfall of 1.46 percent. With projected total employment of 107.48 million in 1985, the size of the discrepancy for unskilled males is 1.57 million workers.

Appendix to Section V

Labor Market Forecast

A. Introduction

The forecasting exercise with the Wharton Annual Model is unique in certain aspects. In common with almost all forecasting models, forecast results are scrutinized for validity and plausibility. But previous to this process, the Annual Model is aligned with the most recent forecast run of the Wharton Quarterly Model. It is felt that the Quarterly Model provides valuable and unique information on the short-term outlook. The Annual Model has been built as a medium to long-term forecasting model designed to detect shifts and trends in the composition of final demand and industry output that are evidenced over these longer time horizons. This is not to say that the Annual Model is cyclically insensitive--many critical sectors exhibit periodic cyclical swings, notably autos and other consumer durables, the housing market and nonresidential investment expenditures.

As part of a typical forecast release, a control solution is created reflecting what we view as the most probable growth path that is consistent with most-likely values for the exogenously specified variables. In addition, our release usually includes a number of alternative scenarios that differ from the control solution either in the policy assumptions applied (such as tax rates and government spending), in the assumptions of foreign economic conditions (such as oil import prices), or in the

strength of various expectational relationships (investment for example). Our labor market forecast is presented similarly. After historical simulation and validation, the labor force model was incorporated into our forecasting model and the labor force simulation is now a part of our forecasting cycle.

Since the unemployment rate equations overidentify our system (labor force and employment determine total unemployment independently of these equations), the equations are constrained to sum to total unemployment. The labor force equations in the sub-model can be used in two modes; in one they are constrained to reproduce the total male and female labor force values calculated in the macro model, and in the second mode they override the macro model and determine labor force within the subroutine. For the control solution, the individual equations are aligned so that the same values are obtained in either mode of operation. For scenario runs, the second mode is invoked so that the impact of various growth paths can be examined for each age-sex category. Much more accurate multiplier responses have been obtained with the model in this mode.

In volume II of this report, two forecasts are presented and are described below. One is the standard control solution and the second simulates higher productivity as a result of stronger nonresidential investment in the 1980's.

B. The Basic Labor Supply Forecast

The outlook for the labor market in the 1980's is dominated by the shifting age distribution that we expect to occur. For the male labor force, this effect should be predominant since labor force participation rates should remain stable or decline somewhat in the age groups near retirement; changes in the labor supply here should be almost solely the result of the aging of the "baby boom" cohorts. The sharp decline in fertility rates in the first years of the 1960's will cause the male labor force ages 20 to 24 to decline in absolute size despite relatively stable participation rates for this age group. The labor force ages 35 to 44 is expected to show the fastest growth in the next decade. This group was the leading edge of the baby boom.

Of all the male age group participation rates, the rates for those over 55 are expected to decline most dramatically. The rate for males 65 and over should continue to decline from 20% to below 17%, despite the increase in the minimum mandatory retirement age. The rate for males age 55 to 64 will decline from 74% to near 66%. Other rates are expected to decline in the neighborhood of 1% to 2%. The decline for prime-age males (ages 25 to 54) is a result of the easing pressure to fulfill the role of sole wage-earner due to higher female participation rates. The teen-aged male labor force counters this trend with a slightly rising participation rate; a falling school enrollment rate is the chief cause. As a result the overall participation

rate for males falls from over 78% in 1978 to 76.7% in 1988.

Participation rates for females should continue their historic upward trend, although at a somewhat slower rate overall. While the labor force participation rate for women sixteen and over rose from 41% to 48% between the 1967 and 1977, our forecast calls for a rate of 53% by 1983 but for the rate to increase by only about one half of one percent per year thereafter. The increase in the overall female participation rates is due to higher participation rates for all age groups between 20 and 54. The overall upward trend in these rates is a result of a continued narrowing of the gap between participation rates for males and females in each age group. While there is some evidence that this began in the late fifties, particularly for the 45 to 54 year-old group, a marked acceleration began in the mid-sixties. We expect this trend to continue at a somewhat slower rate in the forecast period.

The uniformity of the general convergence of female and male participation rates by age groups in our forecast masks a discernible distinction between the rise in rates for the older and the younger of these female age groups. The most dramatic increase in the last decade has occurred in the "child-bearing" cohort ages 25 to 34. One would expect this cohort to continue this new pattern of labor force participation through the remainder of the life-cycle, and the dramatic acceleration of rate gains in the 35 to 44 year old age group can be adduced to support this claim. As a result, we expect some further

increases in participation in this age group but more rapid gains in the 45 to 54 year-old group.

While further increases are expected on the 20 to 24 year old female group and the 25 to 35 year-old female group, these gains are expected to be moderate in comparison to the last decade. It is not that a limit has been reached in removing sexual barriers to employment; we expect this trend to continue albeit at a less dramatic pace. The effects should be most noticable at the career-entry level, ie., ages 20 to 34. A development with increasing significance for labor market will be the two-career household. The female labor force will, over time, consist less of income supplementing "secondary" workers and increasingly of women pursuing an independent career. This should create a larger and more stable female labor force at the end of the 1980's.

These factors will combine to increase the female labor force at an average rate of 2.2% between 1978 and 1988. Despite this rapid gain (the male labor force grows at an average annual rate of 1.0% over the same time period) the unemployment rate for females drops from a 6.05% overall rate in 1978 to 5.20% in 1988. The male unemployment rate falls by only 0.5% over the same period. The fall in the female rate is indicative of the more stable employment patterns expected and the drop is expected to be concentrated in the prime-age groups. The fact that the unemployment rate for prime-age males remains above 3.2% indicates that a good pattern of the overall reduction in unemployment will fall in those groups considered the source of "structural unemployment, such as those groups under 24 years of age.

C. Alternative Scenario; Higher Productivity

For this alternative scenario, real non-residential investment is assumed to rise to a higher share of real GNP than in the control solutions. This produces a growth path this is significantly higher than in the control. Real gross national product grows at an average annual rate of 2.86% in the control solution versus a rate of 3.25% in this alternate solution. Real nonresidential fixed investment in 1988 reaches $221.1 billion in 1972 dollars in the alternate versus $200.8 billion in the control solution. By 1988 real per capita GNP is 4% higher than it is in the control solution.

As would be expected the unemployment rate is substantially lower; 4.32% in the scenario as opposed to 5.0% in the control. The higher income in this scenario also has the expected effect upon the size of the labor force. The labor force reaches a level of 117.38 million people in 1988, 830,000 people more than forecasted in the control scenario. The effect on productivity is equally dramatic. Growth in real GNP per employee averages 1.24% per annum in the control solution and 1.45% per annum in the alternate.

While higher economic activity has increased the size of the labor force, the distribution among age-sex groups remains largely the same. Most participation rates are higher, notably the younger groups, although some of the older groups show slightly lower rates, probably an accelerating retirement effect

embodied in the income term of those equations. The most pronounced effect of higher growth is upon the distribution of unemployment. Although the overall unemployment rate is lower by 0.88% in 1988, the unemplopyment rate for persons under twenty is more than two points lower. The age group from 20 to 24 years shows similar improvement falling to 6.98% in the scenario versus 8.4% in the control solution. The unemployment rate for prime age males is also lower in this scenario run than in the control but the pattern is significantly altered. In the control this rate rose to 4.15% in 1980 and then declined nomotonicly to 3.24% in 1988. In the alternative this rate peaks at only 3.90% in 1980 and then falls to 2.34% in 1985. At that time, however, growth in the labor force ages 25 to 54 begins to respond to the higher growth path and expands more quickly than employment in this age category. The prime-age male unemployment rate begins to rise after 1985, reaching 2.73% in 1988.

VI. CONCLUSION

The research for the second year of the ONR contract has focused on completing the specification of the participation rate, unemployment rate and school enrollment rate equations, and incorporating them into the annual and quarterly WEFA models. Preliminary enlistment equations have also been developed for the Department of Defense and the Navy. The development of the DOD and Navy sectors and their integration into the WEFA model was planned for the third year of the contract. Although the military equations have not been simulated in the context of the WEFA model, some preliminary implications have been developed from the results obtained to date.

The demographic shift in the population, which has been highlighted in the research, will not begin to appear before 1980. In other words, conditions for recruitment of Navy personnel are still relatively favorable today. After 1980, however, conditions for recruitment in the context of the All Volunteer Forces will deteriorate. First, between 1980 and 1995 the number of young people in the population will decline by approximately 25 percent. This decline in both the percentage and asbolute number of young people is unprecedented in the history of the U.S.

Second, the decline in the number of young people in the labor force is likely to be even sharper than the population

decline among 16-24 year olds. The reason is the predicted improvement in the labor market position of young workers over the next decade as the baby bust replaces the baby boom cohort. The shortage of young workers will be aggrevated by a number of factors. School enrollments rates are expected to increase once again. Enrollment rates for the 16-19 age group peaked in the late 1960's, declined through the early 70's, and stabilized thereafter. The changing demographics are likely to lead to new peaks in school enrollments rates for young people. Partiicpation rates for younger females are likely to stablize after exhibiting dramatic increases during the 1970's. Further significant increases in the percentage of younger females in the labor force will therefore not be able to provide an off-set to the declining population numbers.

Third, the U_N pool of structurally unemployed workers should decline substantially. Since this group provides an important core of enlistees, the decline in their numbers will be parti-cularly significant for the military. To an important extent, the anticipated decline in U_N for youth is a reflection of the long-run tightening of the youth labor market associated with the population decline.

Fourth, as a further result of the shortage of young workers, their relative wages will increase substantially. That is, industries that hire young people will find their wage bill increasing more rapidly than wages being paid by other industries. The hardest hit industries will be those that can be labeled as

"inferior" occupations or industries. As defined by the Gates Commission report, an inferior industry is an industry that must increase its wages faster than the national average. This reflects the notion that as wealth increases, nonpay factors become relatively more important. To maintain the labor supply in an inferior industry thus requires larger wage increases to compensate for the nonpecuniary disadvantages associated with the job. Historically, largely due to data from the draft period, the military has been viewed as an inferior occupation. Although it is not clear whether this still holds today, our results suggest that such a perception is probable.

To summarize, the Navy in an All Volunteer Armed Forces environment will face a recruitment squeeze from four interrelated causes. First, there will be the 25 percent decline in the young people in the population. Second, this will induce an even larger decline in the percentage of young people available in the labor force. Third, the number of young people in the U_N pool will decline. Finally, relative wages will increase for this age group. The military will thus find itself competing for workers from a small cohort. Wages will not only have to increase, but will have to increase faster than the national average.

The experience of the All Volunteer Armed Forces in this climate, will depend upon the ability of the armed forces to diversify their recruitment base. It will become even

Source: Wachter, Michael L., "The Labor Market Mechanism and Immigration: The Outlook for the 1980's," Prepared for the Interagency Task Force on Immigration, Industrial Labor Relations Review, forthcoming 1980.

more important to retain individuals who are already in the Navy. It may become increasingly necessary to draw new recruits from other age groups. The recruitment of older workers, however, will not be a simple task. Moreover, since older workers have higher wages than younger workers, wage costs will increase.

To conclude, although our research is not completed, preliminary results suggest that the AVF system is likely to face considerable difficulties in meeting quantity and quality objectives in the 1980's. Moreover, as suggested by the low elasticities of the labor supply with respect to military pay, the increases in compensation that would be necessary to maintain the desired personnel are likely to be very large.

The next step in the research plan is to finalize the military equations and the forecasts of overall labor supply and demand conditions in the 1980's. This would permit specific dollar cost estimates of an AVF, with alternative personnel targets, in the economic-demographic environment of the 1980's.

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